



4-Bit Bidirectional Universal Shift Register

The MC74AC194/74ACT194 is a high-speed 4-bit bidirectional universal shift register. As a high-speed multifunctional, sequential building block, it is useful in a wide variety of applications. It may be used in serial-serial, shift left, shift right, serial-parallel, parallel-serial, and parallel-parallel data register transfers. The 'AC/ACT194 is similar in operation to the 'AS195 universal shift register, with added features of shift left without external connections and hold (do nothing) modes of operation.

- Typical Shift Frequency of 150 MHz
- Asynchronous Master Reset
- Hold (Do Nothing) Mode
- Fully Synchronous Serial or Parallel Data Transfers

FUNCTIONAL DESCRIPTION

The MC74AC/74ACT194 contains four edge-triggered D flip-flops and the necessary interstage logic to synchronously perform shift right, shift left, parallel load and hold operations. Signals applied to the Select (S_0 , S_1) inputs determine the type of operation, as shown in the Mode Select Table. Signals on the Select, Parallel data (P_0 – P_3) and Serial data (DSR , DSL) inputs can change when the clock is in either state, provided only that the recommended setup and hold times, with respect to the clock rising edge, are observed. A LOW signal on Master Reset (\overline{MR}) overrides all other inputs and forces the outputs LOW.

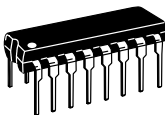
MODE SELECT TABLE

Operating Mode	Inputs						Outputs			
	MR	S_1	S_0	DSR	DSL	P_n	Q_0	Q_1	Q_2	Q_3
Reset	L	X	X	X	X	X	L	L	L	L
Hold	H	l	l	X	X	X	q_0	q_1	q_2	q_3
Shift Left	H	h	l	X	l	X	q_1	q_2	q_3	L
	H	h	l	X	h	X	q_1	q_2	q_3	H
Shift Right	H	l	h	l	X	X	L	q_0	q_1	q_2
	H	l	h	h	X	X	H	q_0	q_1	q_2
Parallel Load	H	h	h	X	X	p_n	P_0	P_1	P_2	P_3

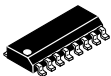
l = LOW voltage level one setup time prior to the LOW-to-HIGH clock transition.
 h = HIGH voltage level one setup time prior to the LOW-to-HIGH clock transition.
 P_n (q_n) = Lower case letters indicate the state of the referenced input (or output) one setup time prior to the LOW-to-HIGH clock transition.
 H = HIGH Voltage Level
 L = LOW Voltage Level
 X = Immaterial

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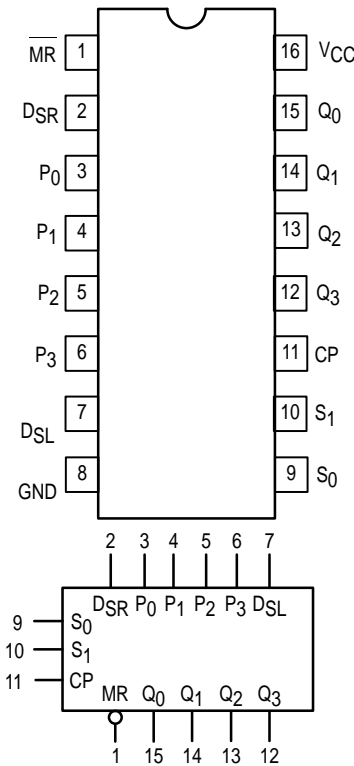
4-BIT BIDIRECTIONAL UNIVERSAL SHIFT REGISTER



N SUFFIX
CASE 648-08
PLASTIC

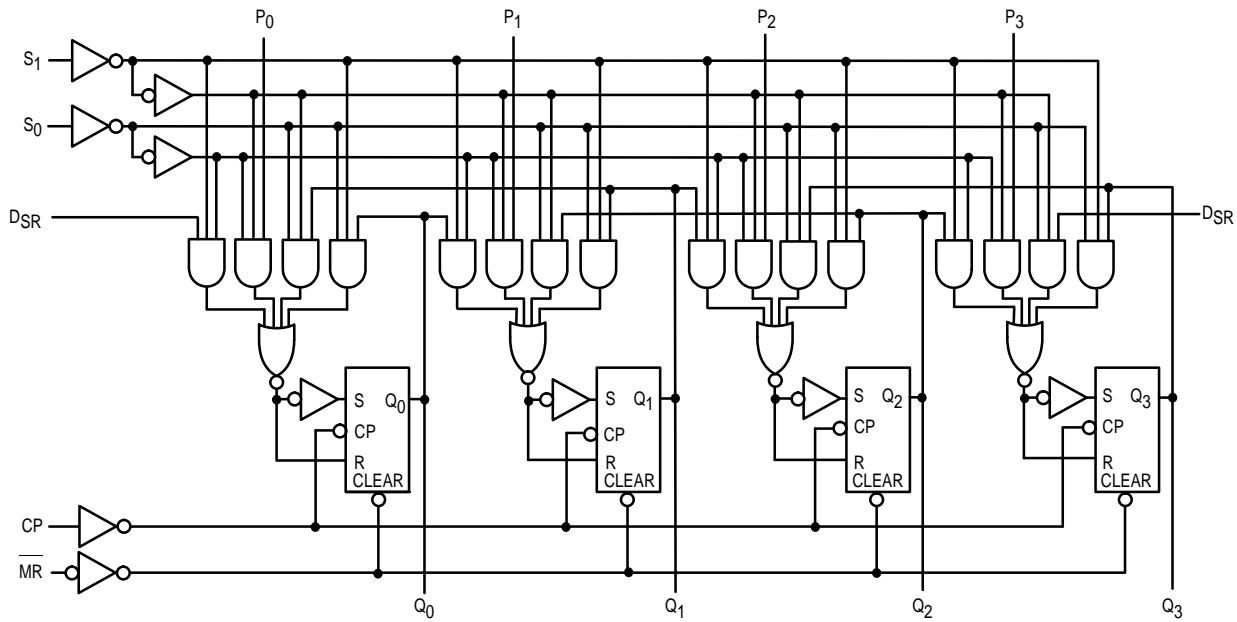


D SUFFIX
CASE 751B-05
PLASTIC



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LOGIC DIAGRAM



Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

MAXIMUM RATINGS*

Symbol	Parameter	Value	Unit
V _{CC}	DC Supply Voltage (Referenced to GND)	−0.5 to +7.0	V
V _{in}	DC Input Voltage (Referenced to GND)	−0.5 to V _{CC} +0.5	V
V _{out}	DC Output Voltage (Referenced to GND)	−0.5 to V _{CC} +0.5	V
I _{in}	DC Input Current, per Pin	±20	mA
I _{out}	DC Output Sink/Source Current, per Pin	±50	mA
I _{CC}	DC V _{CC} or GND Current per Output Pin	±50	mA
T _{stg}	Storage Temperature	−65 to +150	°C

* Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.

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RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit
V _{CC}	Supply Voltage	'AC	2.0	5.0	V
		'ACT	4.5	5.0	
V _{in} , V _{out}	DC Input Voltage, Output Voltage (Ref. to GND)	0		V _{CC}	V
t _r , t _f	Input Rise and Fall Time (Note 1) 'AC Devices except Schmitt Inputs	V _{CC} @ 3.0 V	150		ns/V
		V _{CC} @ 4.5 V	40		
		V _{CC} @ 5.5 V	25		
t _r , t _f	Input Rise and Fall Time (Note 2) 'ACT Devices except Schmitt Inputs	V _{CC} @ 4.5 V	10		ns/V
		V _{CC} @ 5.5 V	8.0		
T _J	Junction Temperature (PDIP)			140	°C
T _A	Operating Ambient Temperature Range	−40	25	85	°C
I _{OH}	Output Current — High			−24	mA
I _{OL}	Output Current — Low			24	mA

1. V_{in} from 30% to 70% V_{CC}; see individual Data Sheets for devices that differ from the typical input rise and fall times.

2. V_{in} from 0.8 V to 2.0 V; see individual Data Sheets for devices that differ from the typical input rise and fall times.

DC CHARACTERISTICS

Symbol	Parameter	V _{CC} (V)	74AC		74AC		Unit	Conditions
			T _A = +25°C		T _A = −40°C to +85°C			
			Typ	Guaranteed Limits				
V _{IH}	Minimum High Level Input Voltage	3.0	1.5	2.1	2.1	V	V _{OUT} = 0.1 V or V _{CC} − 0.1 V	
		4.5	2.25	3.15	3.15			
		5.5	2.75	3.85	3.85			
V _{IL}	Maximum Low Level Input Voltage	3.0	1.5	0.9	0.9	V	V _{OUT} = 0.1 V or V _{CC} − 0.1 V	
		4.5	2.25	1.35	1.35			
		5.5	2.75	1.65	1.65			
V _{OH}	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9	V	I _{OUT} = −50 μA	
		4.5	4.49	4.4	4.4			
		5.5	5.49	5.4	5.4			
		3.0		2.56	2.46	V	*V _{IN} = V _{IL} or V _{IH} −12 mA I _{OH} −24 mA −24 mA	
		4.5		3.86	3.76			
		5.5		4.86	4.76			
V _{OL}	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1	V	I _{OUT} = 50 μA	
		4.5	0.001	0.1	0.1			
		5.5	0.001	0.1	0.1			
		3.0		0.36	0.44	V	*V _{IN} = V _{IL} or V _{IH} 12 mA I _{OL} 24 mA 24 mA	
		4.5		0.36	0.44			
		5.5		0.36	0.44			
I _{IN}	Maximum Input Leakage Current	5.5		±0.1	±1.0	μA	V _I = V _{CC} , GND	
I _{OLD}	†Minimum Dynamic Output Current	5.5			75	mA	V _{OLD} = 1.65 V Max	
I _{OHD}		5.5			−75	mA	V _{OHD} = 3.85 V Min	
I _{CC}	Maximum Quiescent Supply Current	5.5		8.0	80	μA	V _{IN} = V _{CC} or GND	

* All outputs loaded; thresholds on input associated with output under test.

† Maximum test duration 2.0 ms, one output loaded at a time.

Note: I_{IN} and I_{CC} @ 3.0 V are guaranteed to be less than or equal to the respective limit @ 5.5 V V_{CC}.

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AC CHARACTERISTICS (For Figures and Waveforms — See Section 3)

Symbol	Parameter	V _{CC} * (V)	74AC		74AC		Unit	Fig. No.
			T _A = +25°C C _L = 50 pF		T _A = −40°C to +85°C C _L = 50 pF			
			Min	Max	Min	Max		
f _{max}	Maximum Input Frequency	3.3 5.0	130 210		115 150		MHz	3-3
t _{PLH}	Propagation Delay CP to Q	3.3 5.0	2.0 2.0	14.5 12.5	1.5 1.5	16.0 14.0	ns	3-6
t _{PHL}	Propagation Delay CP to Q	3.3 5.0	2.0 2.0	14.5 12.5	1.5 1.5	16.0 14.0	ns	3-6
t _{PHL}	Propagation Delay Reset to Q	3.3 5.0	2.0 2.0	11.0 9.0	1.5 1.5	12.0 10.0	ns	3-6

* Voltage Range 3.3 V is 3.3 V ±0.3 V.
Voltage Range 5.0 V is 5.0 V ±0.5 V.

AC OPERATING REQUIREMENTS

Symbol	Parameter	V _{CC} * (V)	74AC	74AC	Unit	Fig. No.
			T _A = +25°C C _L = 50 pF	T _A = −40°C to +85°C C _L = 50 pF		
			Guaranteed Minimum			
t _s	Setup Time, P _n to Clock	3.3 5.0	4.0 2.5	5.0 3.5	ns	3-9
t _h	Hold Time, P _n to Clock	3.3 5.0	3.5 2.0	4.0 2.5	ns	3-9
t _s	Setup Time, S _n to CP	3.3 5.0	5.5 4.0	6.5 5.0	ns	3-9
t _h	Hold Time, S _n to CP	3.3 5.0	3.5 2.0	4.0 2.5	ns	3-9
t _s	Setup Time, DSR or DSL to Clock	3.3 5.0	5.5 4.0	6.0 4.5	ns	3-9
t _h	Hold Time, DSR or DSL to Clock	3.3 5.0	1.5 2.0	2.0 2.5	ns	3-9
t _w	CP Pulse Width	3.3 5.0	5.5 4.0	6.0 4.5	ns	3-6
t _w	MR Pulse Width	3.3 5.0	5.5 4.0	6.0 4.5	ns	3-9
t _{rec}	Recovery Time MR to CP	3.3 5.0	1.5 1.0	1.5 1.0	ns	3-9

* Voltage Range 3.3 V is 3.3 V ±0.3 V.
Voltage Range 5.0 V is 5.0 V ±0.5 V.

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DC CHARACTERISTICS

Symbol	Parameter	V _{CC} (V)	74ACT		74ACT		Unit	Conditions
			T _A = +25°C		T _A = −40°C to +85°C			
			Typ	Guaranteed Limits				
V _{IH}	Minimum High Level Input Voltage	4.5 5.5	1.5 1.5	2.0 2.0	2.0 2.0	V	V _{OUT} = 0.1 V or V _{CC} − 0.1 V	
V _{IL}	Maximum Low Level Input Voltage	4.5 5.5	1.5 1.5	0.8 0.8	0.8 0.8	V	V _{OUT} = 0.1 V or V _{CC} − 0.1 V	
V _{OH}	Minimum High Level Output Voltage	4.5 5.5	4.49 5.49	4.4 5.4	4.4 5.4	V	I _{OUT} = −50 μA	
		4.5 5.5		3.86 4.86	3.76 4.76	V	*V _{IN} = V _{IL} or V _{IH} −24 mA I _{OH} −24 mA	
V _{OL}	Maximum Low Level Output Voltage	4.5 5.5	0.001 0.001	0.1 0.1	0.1 0.1	V	I _{OUT} = 50 μA	
		4.5 5.5		0.36 0.36	0.44 0.44	V	*V _{IN} = V _{IL} or V _{IH} 24 mA I _{OL} 24 mA	
I _{IN}	Maximum Input Leakage Current	5.5		±0.1	±1.0	μA	V _I = V _{CC} , GND	
ΔI _{CCT}	Additional Max. I _{CC} /Input	5.5	0.6		1.5	mA	V _I = V _{CC} − 2.1 V	
I _{OLD}	†Minimum Dynamic Output Current	5.5			75	mA	V _{OLD} = 1.65 V Max	
I _{OHD}		5.5			−75	mA	V _{OHD} = 3.85 V Min	
I _{CC}	Maximum Quiescent Supply Current	5.5		8.0	80	μA	V _{IN} = V _{CC} or GND	

* All outputs loaded; thresholds on input associated with output under test.

† Maximum test duration 2.0 ms, one output loaded at a time.

AC CHARACTERISTICS (For Figures and Waveforms — See Section 3)

Symbol	Parameter	V _{CC} * (V)	74ACT			74ACT		Unit	Fig. No.
			T _A = +25°C C _L = 50 pF			T _A = −40°C to +85°C C _L = 50 pF			
			Min	Typ	Max	Min	Max		
f _{max}	Maximum Input Frequency	5.0	210			150		MHz	3-3
t _{PLH}	Propagation Delay CP to Q	5.0	2.0		13.0	1.5	13.5	ns	3-6
t _{PHL}	Propagation Delay CP to Q	5.0	2.0		12.5	1.5	14.0	ns	3-6
t _{PHL}	Propagation Delay MR to Q	5.0	2.0		12.5	1.5	14.0	ns	3-6

* Voltage Range 5.0 V is 5.0 V ±0.5 V.

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AC OPERATING REQUIREMENTS

Symbol	Parameter	V _{CC} * (V)	74ACT	74ACT	Unit	Fig. No.
			T _A = +25°C C _L = 50 pF	T _A = −40°C to +85°C C _L = 50 pF		
			Guaranteed Minimum			
t _s	Setup Time, P _n to CP	5.0	2.5	3.5	ns	3-9
t _h	Hold Time, P _n to CP	5.0	1.5	2.0	ns	3-9
t _s	Setup Time, S _n to CP	5.0	3.5	4.5	ns	3-9
t _h	Hold Time, S _n to CP	5.0	1.5	2.0	ns	3-9
t _s	Setup Time, DSR or DSL to Clock	5.0	5.0	5.5	ns	3-9
t _h	Hold Time, DSR or DSL to Clock	5.0	1.5	2.0	ns	3-9
t _w	CP Pulse Width	5.0	4.0	4.5	ns	3-9
t _w	MR Pulse Width, LOW	5.0	4.0	4.5	ns	3-9
t _{rec}	Recovery Time MR to CP	5.0	1.0	1.5	ns	3-9

* Voltage Range 5.0 V is 5.0 V ±0.5 V.

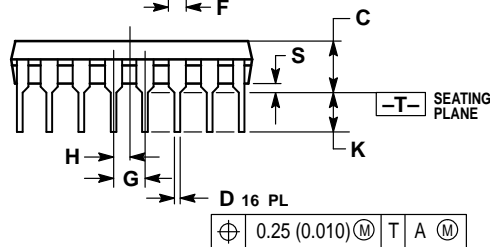
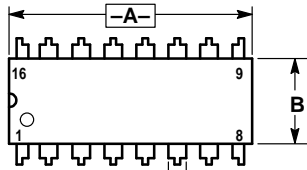
CAPACITANCE

Symbol	Parameter	Value Typ	Unit	Test Conditions
C _{IN}	Input Capacitance	4.5	pF	V _{CC} = 5.0 V
C _{PD}	Power Dissipation Capacitance	125.0	pF	V _{CC} = 5.0 V

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OUTLINE DIMENSIONS

N SUFFIX PLASTIC DIP PACKAGE CASE 648-08 ISSUE R

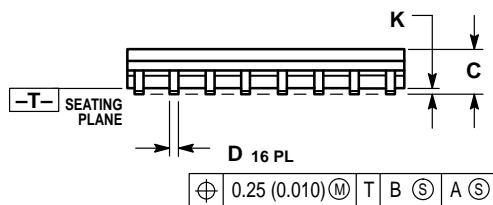
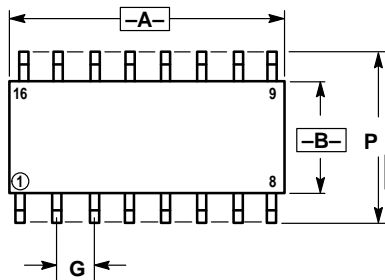


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0°	10°	0°	10°
S	0.020	0.040	0.51	1.01


D SUFFIX PLASTIC SOIC PACKAGE CASE 751B-05 ISSUE J



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

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MC74AC194/D

